Report of ~~ILCA~~ Study

Mid-Point Algorithm

This talk summarizes a study of the 'Mid-Point' algorithm applied to the cone jet finder in D-Zero RunI Data.

The primary data sample is a collection of W->JJ triggers taken at high instantaneous luminosity ($17.7E30 cm^{-2}.sec^{-1}$)

these triggers essentially select events containing
2 low ET, central jets (|eta| < ~ 1.6, ET>~20GeV) -
a small sample of large ET jet triggers is also included

ILCA = Improved Legacy Cone Algorithm - too hard to say!

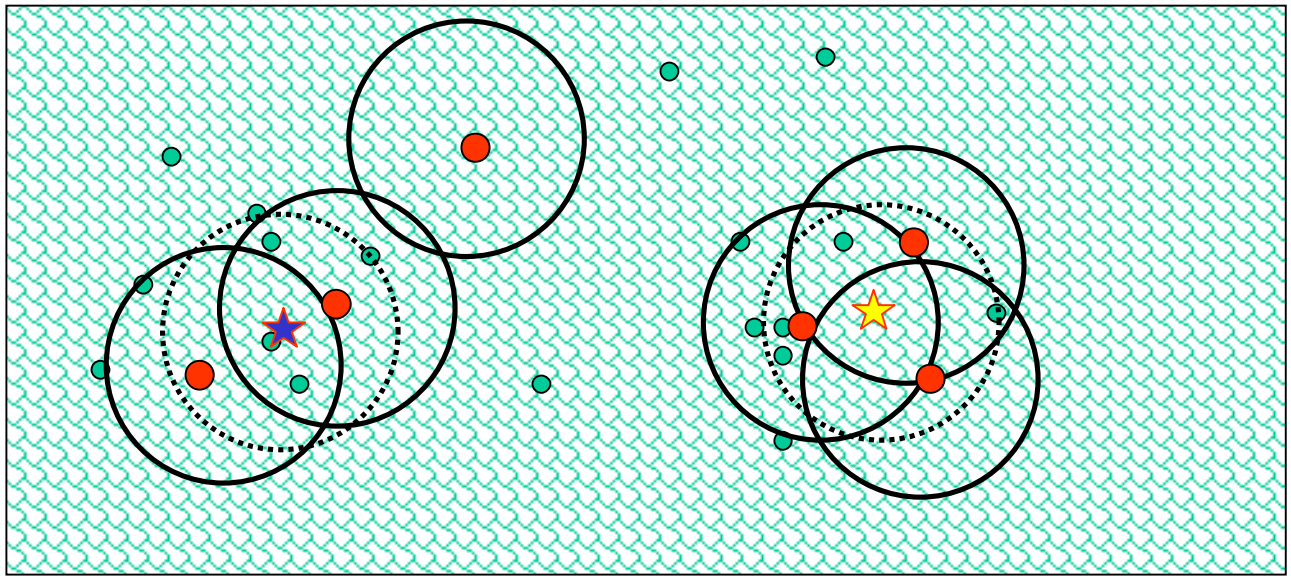
UPDATE **Bob Hirosky Sep 99 hirosky@fnal.gov**

Jets are clustered around seeds/preclusters =

calorimeter towers > threshold

The Mid Point algorithm adds new 'pseudo seeds' between each pair of jet seeds satisfying the distance (ΔR) requirement:

$R_{cone} < \Delta R < 2 * R_{cone}$ ILCA adds starting points



● Seed > ~1 GeV ★ ☆ ILCA added seeds placed at ET-weighted midpoints

UPDATE **Bob Hirosky Sep 99 hirosky@fnal.gov**

Additional Preclusters

Algorithm cone size	Legacy Alg (1,.7,.5,.3)	MidPoint (1,.7,.5,.3)	MidPoint+triangle centers (1,.7,.5,.3)
<#preclu> (~10-50 GeV)	12	21,23,26,20	21,24,31,23
<#preclu> (~300 GeV)	10	15,19,20,15	15,21,22,16

In a preliminary version of this study, virtually no difference was observed when adding the triangle centers to the midpoint algorithm. The midpoint data herein include only the addition of ET-weighted midpoints

UPDATE **Bob Hirosky Sep 99 hirosky@fnal.gov**

The D-Zero Cone Algorithm

To a significant extent the study of perturbations in cone jet algorithms, is a study of the effect of the perturbation on splitting and merging criteria and threshold effects for jet finding.

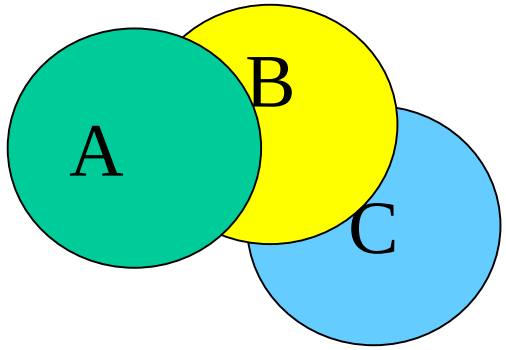
The D-Zero cone algorithm, clusters jets in cones around seed towers w/ ET>1.0GeV. Jets w/ overlapping cones may either be split or merged, depending on the jet ET's and the amount of shared energy.

If the shared ET of two jets is > 50% of the ET of the smaller jet, then the two jets are merged, otherwise the shared energy is split between the two with each cell being assigned to the jet with the nearest centroid.

UPDATE **Bob Hirosky Sep 99 hirosky@fnal.gov**

The D-Zero Cone Algorithm and Order Dependencies

Consider 3 overlapping jets:
how might they be merged?
The 'correct' answer becomes ambiguous
and complex when more than 2 jets are involved



In the D-Zero algorithm, jets are found by clustering around seeds in DECENDING seed order.

When a new jet is found it is compared to previously found jets and splitting or merging is applied based on the energy shared w/ these jets. Therefore changing the 'order' of jet finding can affect the splitting and merging possibilities for a particular jet.

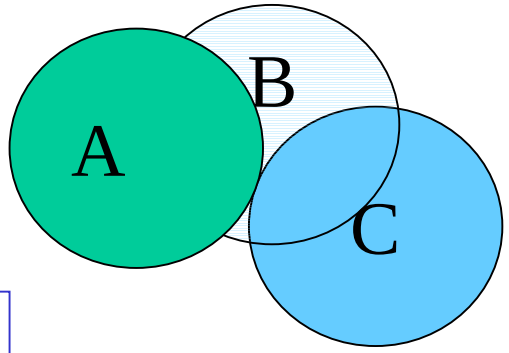
UPDATE Bob Hirosky Sep 99 hirosky@fnal.gov

One Simple Example

Assume (B<C<A) & B∩C>B/2 & B∩A<B/2

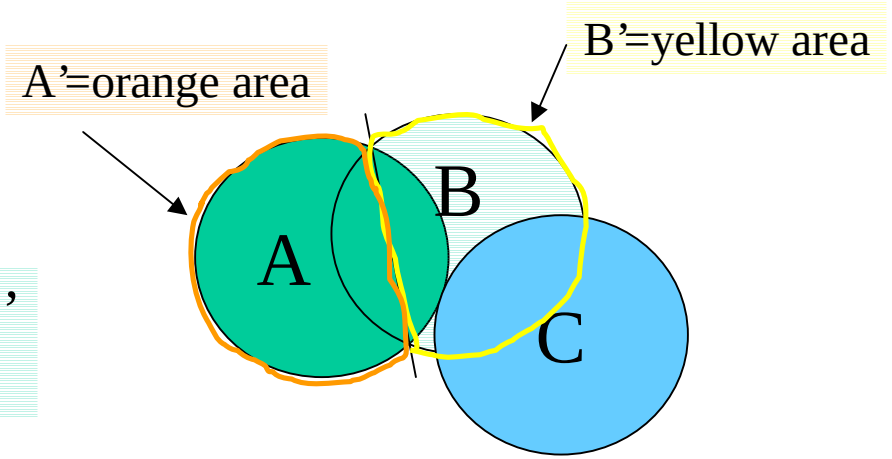
Order of jet finding: A,C,B

A->A
C-> C+B-(B∩A), B->0



Note: only towers unique to B are
available for merging w/ C in the DZero strategy

Order of jet finding: B,A,C



B&A are split A->A', B->B'
C-> C+B' , B'->0

UPDATE Bob Hirosky Sep 99 hirosky@fnal.gov

The order in which jets are found will affect the final jet sample in the case of split and/or merged jets.

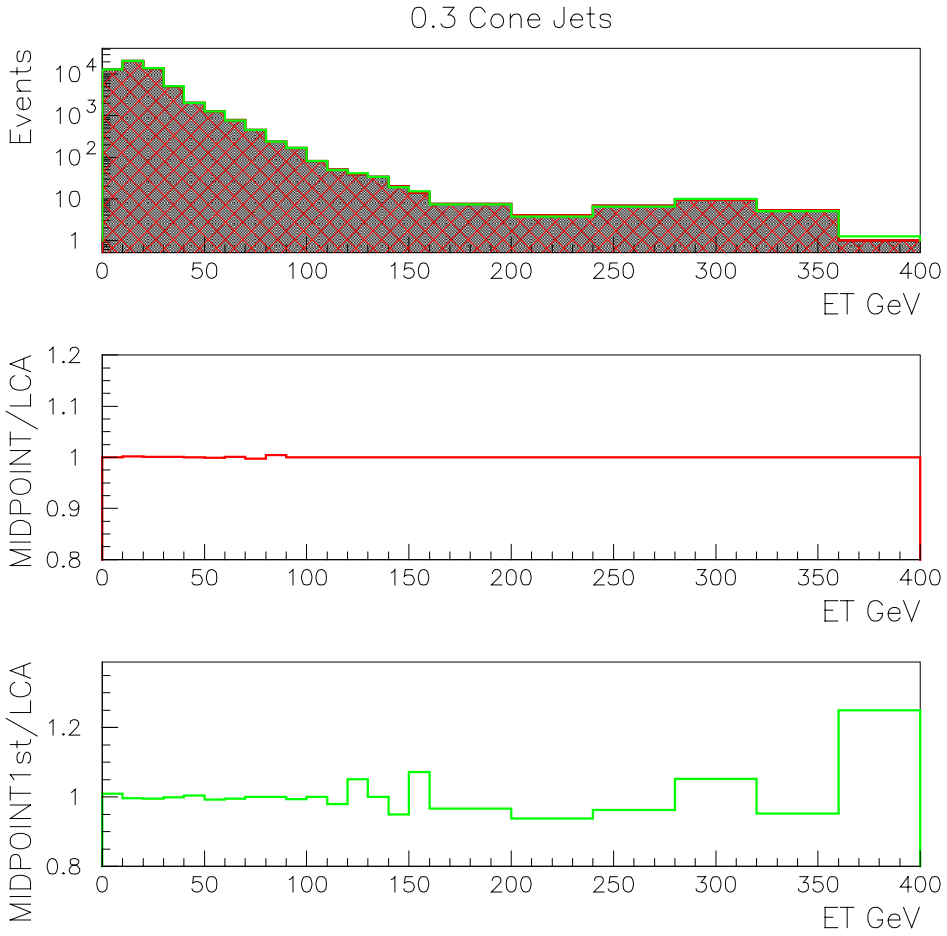
To study the extent of this dependence on the results of the midpoint algorithm study, I include two versions of the midpoint algorithm.

1) jet clustering is done around the mid points after ALL the standard seeds have been used (MIDPOINT algorithm)

2) jets are clustered around mid points BEFORE any standard seeds are used (MIDPOINT-1ST algorithm)

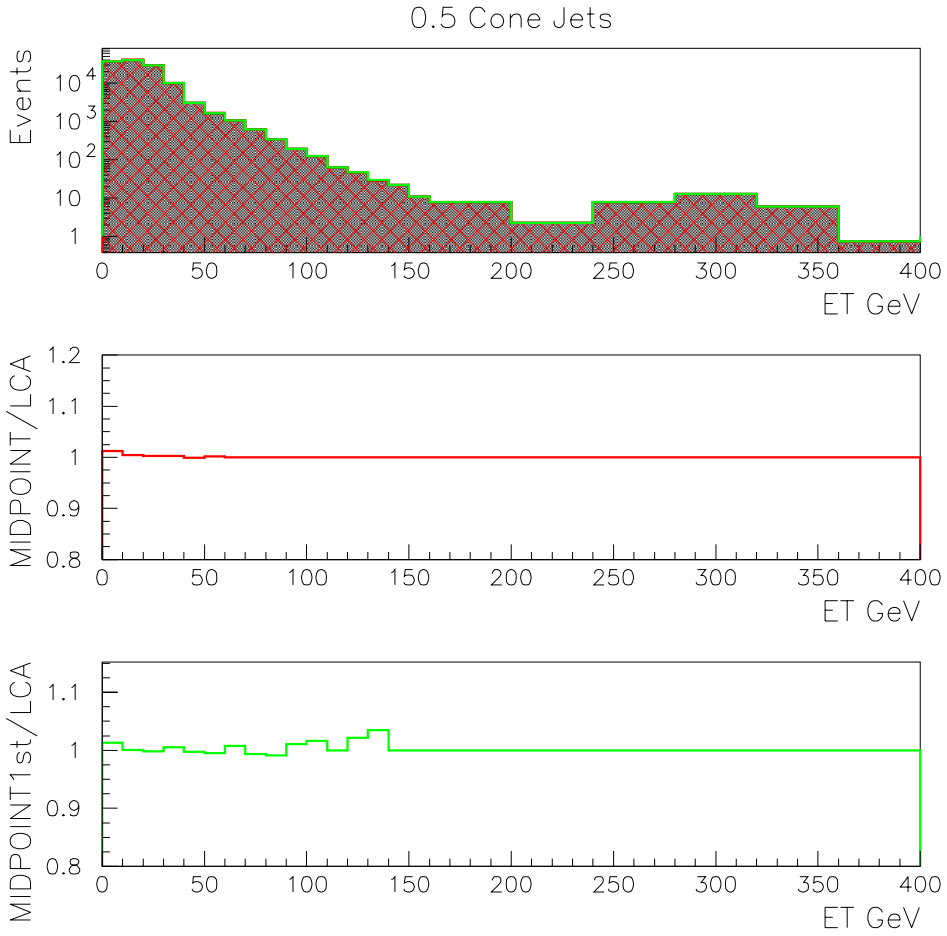
UPDATE **Bob Hirosky Sep 99 hirosky@fnal.gov**

Ratio of Jet ET Spectra for LCA, and MidPoint variations



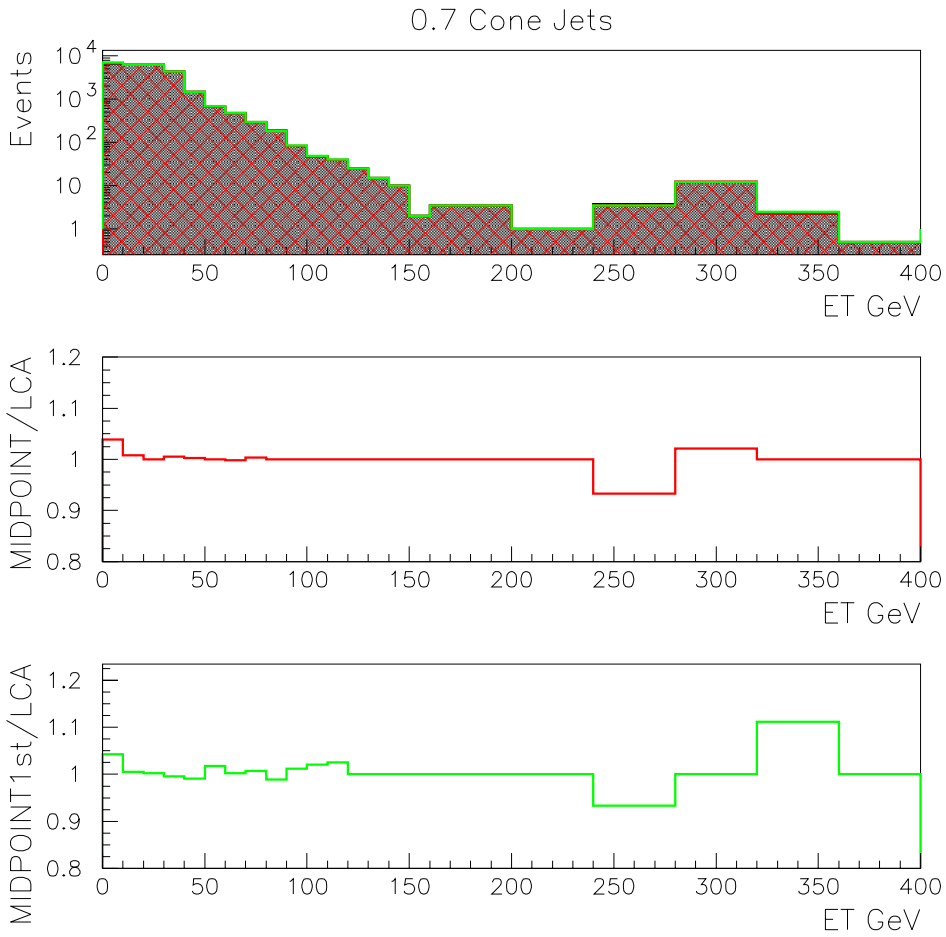
****UPDATE**** **Bob Hirosky Sep 99 hirosky@fnal.gov**

Ratio of Jet ET Spectra for LCA, and MidPoint variations



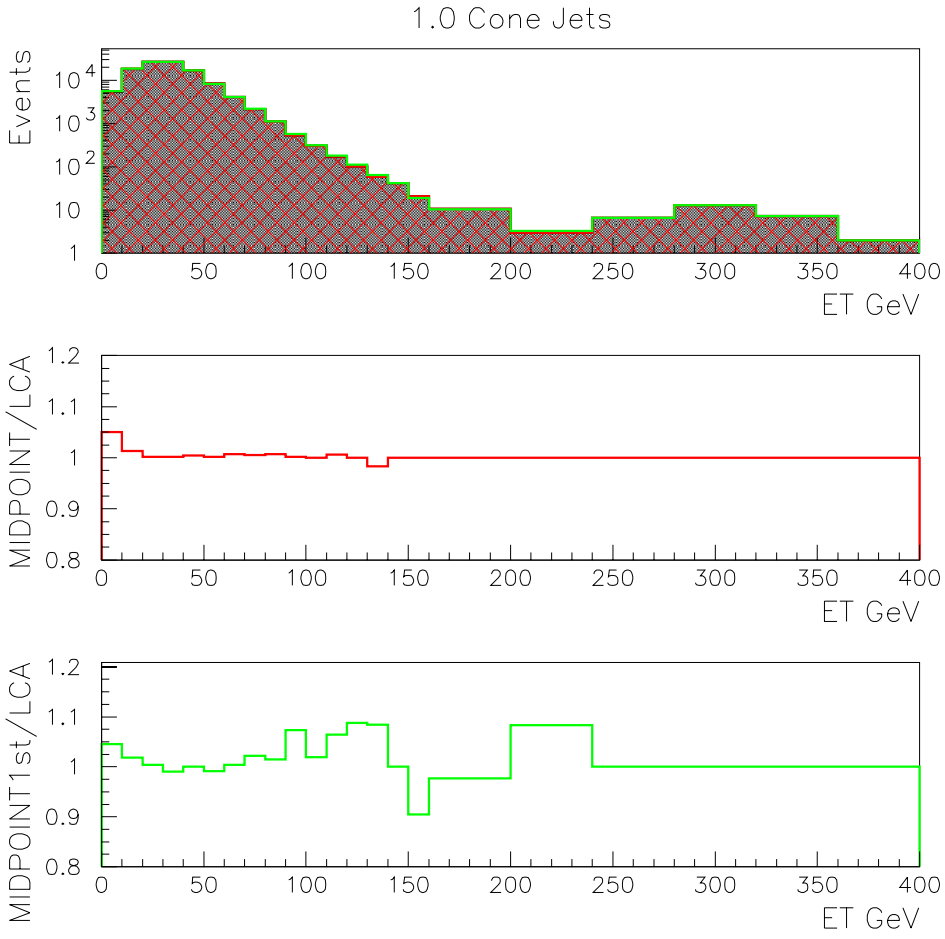
****UPDATE** Bob Hirosky Sep 99 hirosky@fnal.gov**

Ratio of Jet ET Spectra for LCA, and MidPoint variations



****UPDATE** Bob Hirosky Sep 99 hirosky@fnal.gov**

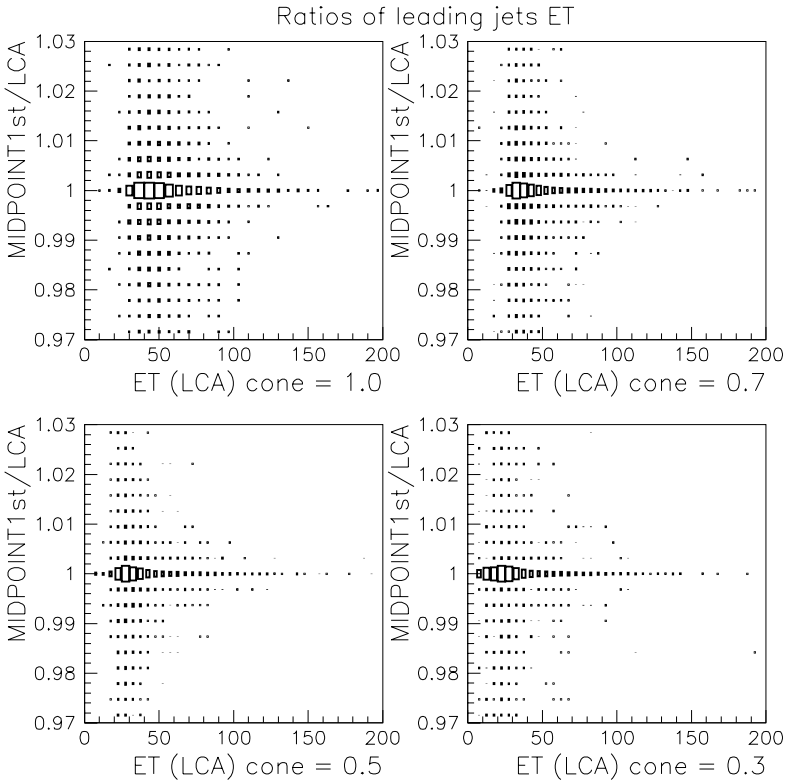
Ratio of Jet ET Spectra for LCA, and MidPoint variations



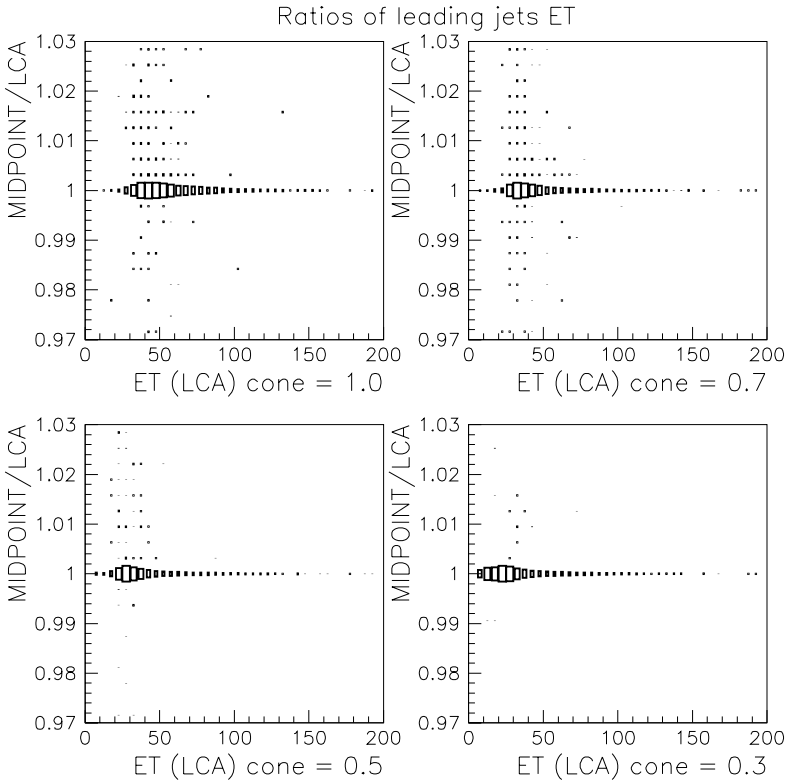
UPDATE **Bob Hirosky Sep 99 hirosky@fnal.gov**

Ratios of Leading Jet ET, between LCA and MIDPOINT Algs (Jets are matched in eta-phi space)

MidPoint_1st



MidPoint



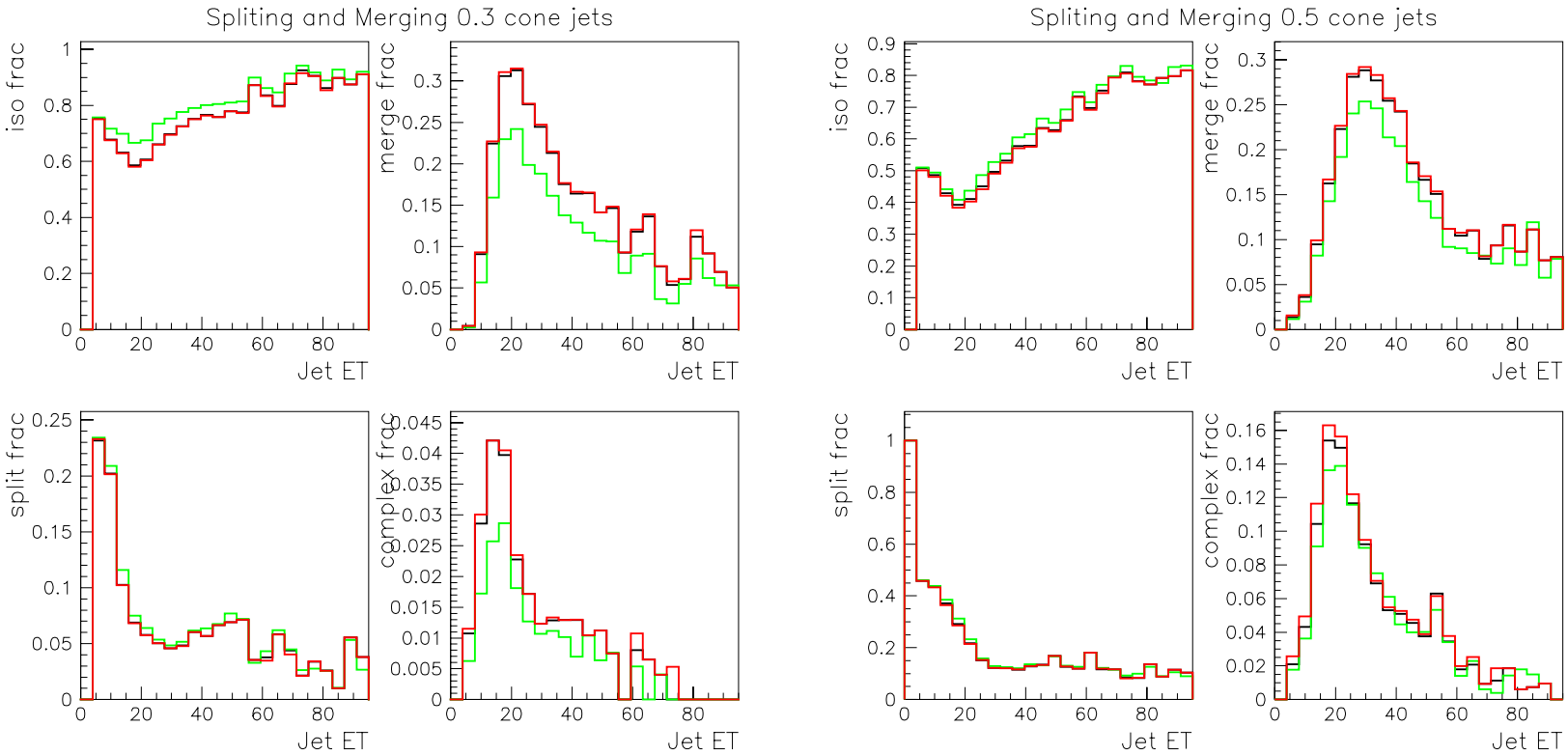
UPDATE **Bob Hirosky Sep 99 hirosky@fnal.gov**

Fractions of Isolated, Split, Merged, and Complex Jets vs. ET

LCA

MidPoint

MidPoint 1st



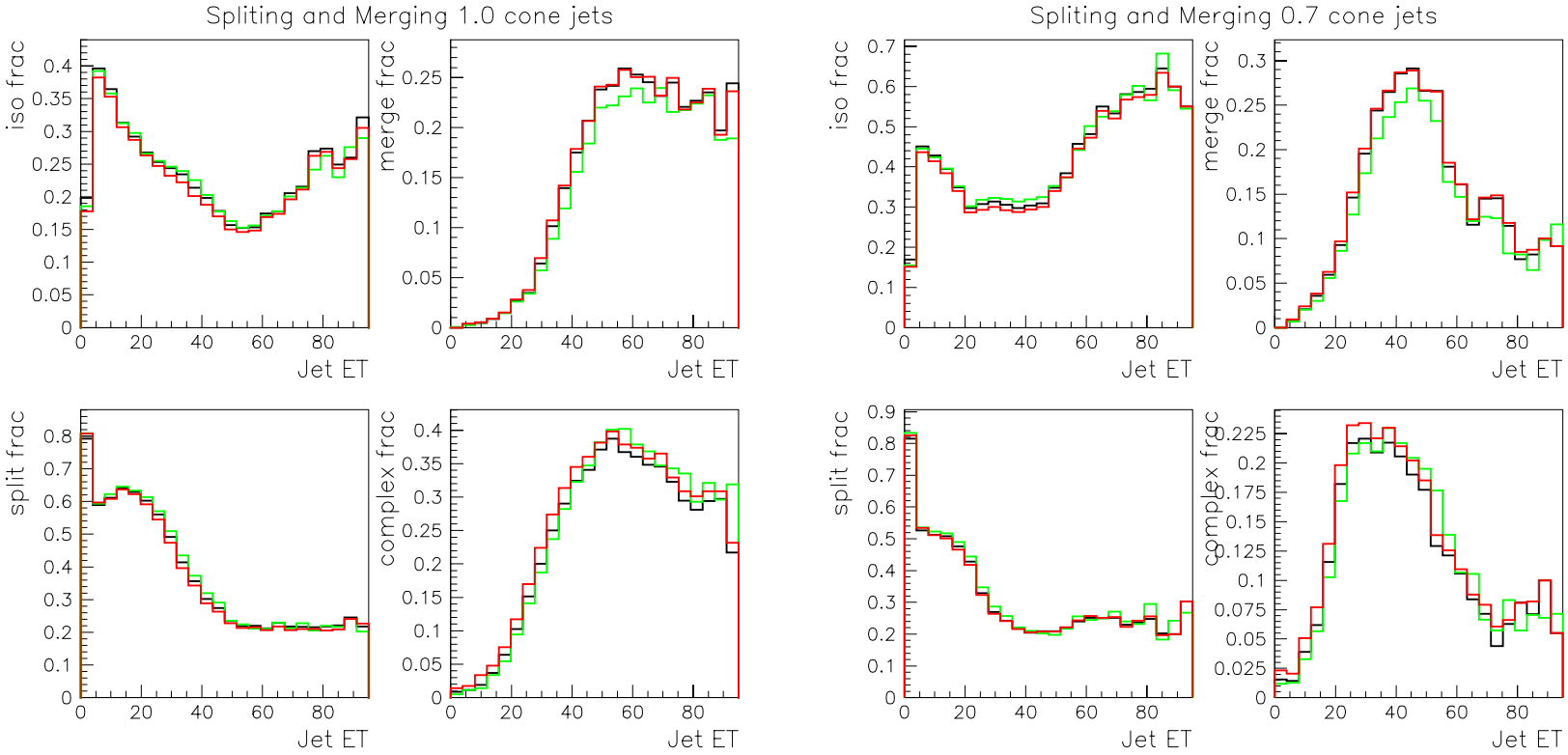
UPDATE **Bob Hirosky Sep 99 hirosky@fnal.gov**

Fractions of Isolated, Split, Merged, and Complex Jets vs. ET

LCA

MidPoint

MidPoint 1st



UPDATE **Bob Hirosky Sep 99 hirosky@fnal.gov**

Note: the previous 4 figures, show a very large amount
of splitting and merging for larger jet cones. This is because the
average number of interactions per beam crossing in the sample
was <2.8> w/ a poisson distribution -
hence the large number of split/merged and complex jets.

The following four plots show the same distributions w/ restrictions
on the distributions in the luminosity monitors for each event.
In this case the restricted sample is dominated by events w/ two or less
interactions and less spliting/merging is evident in the larger cone jets.
These more closely resemble typical Run1 distributions.

It is clear that the trend is the same for the midpoint algorithm in either
event sample.

UPDATE **Bob Hirosky Sep 99 hirosky@fnal.gov**

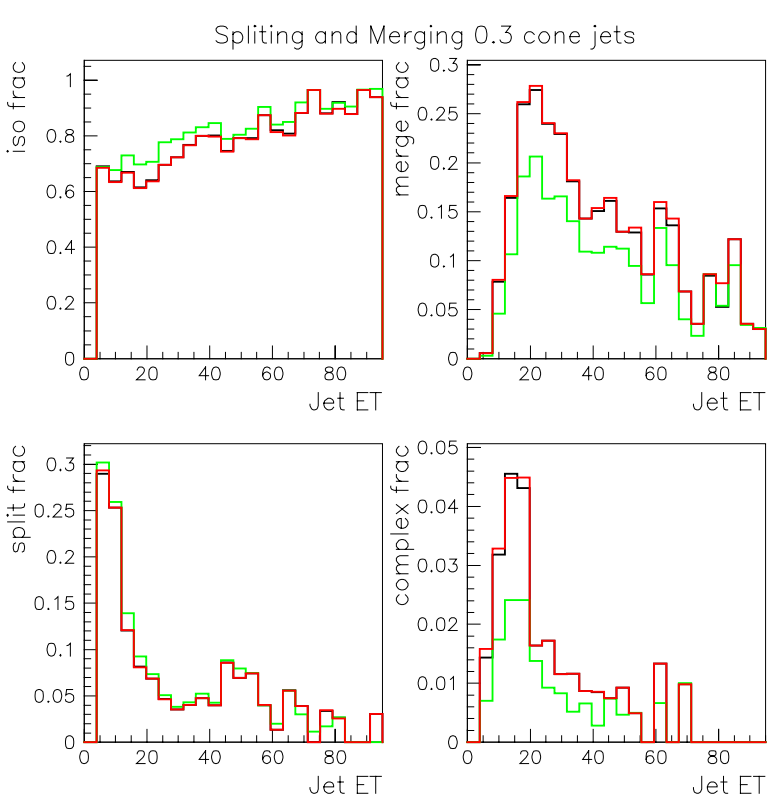
Fractions of Isolated, Split, Merged, and Complex Jets vs. ET

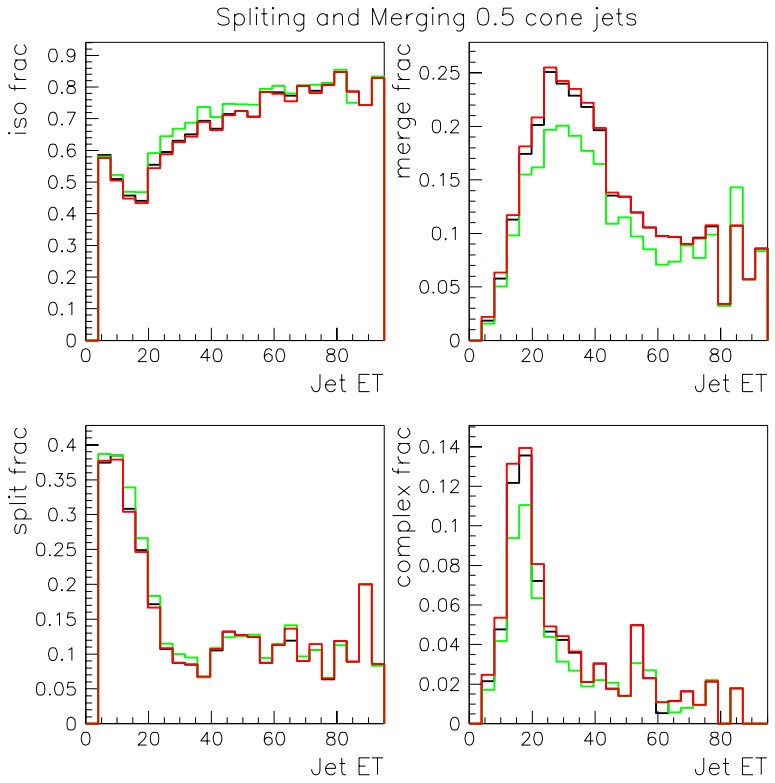
LCA

MidPoint

MidPoint 1st

+Interaction cut





UPDATE Bob Hirosky Sep 99 hirosky@fnal.gov

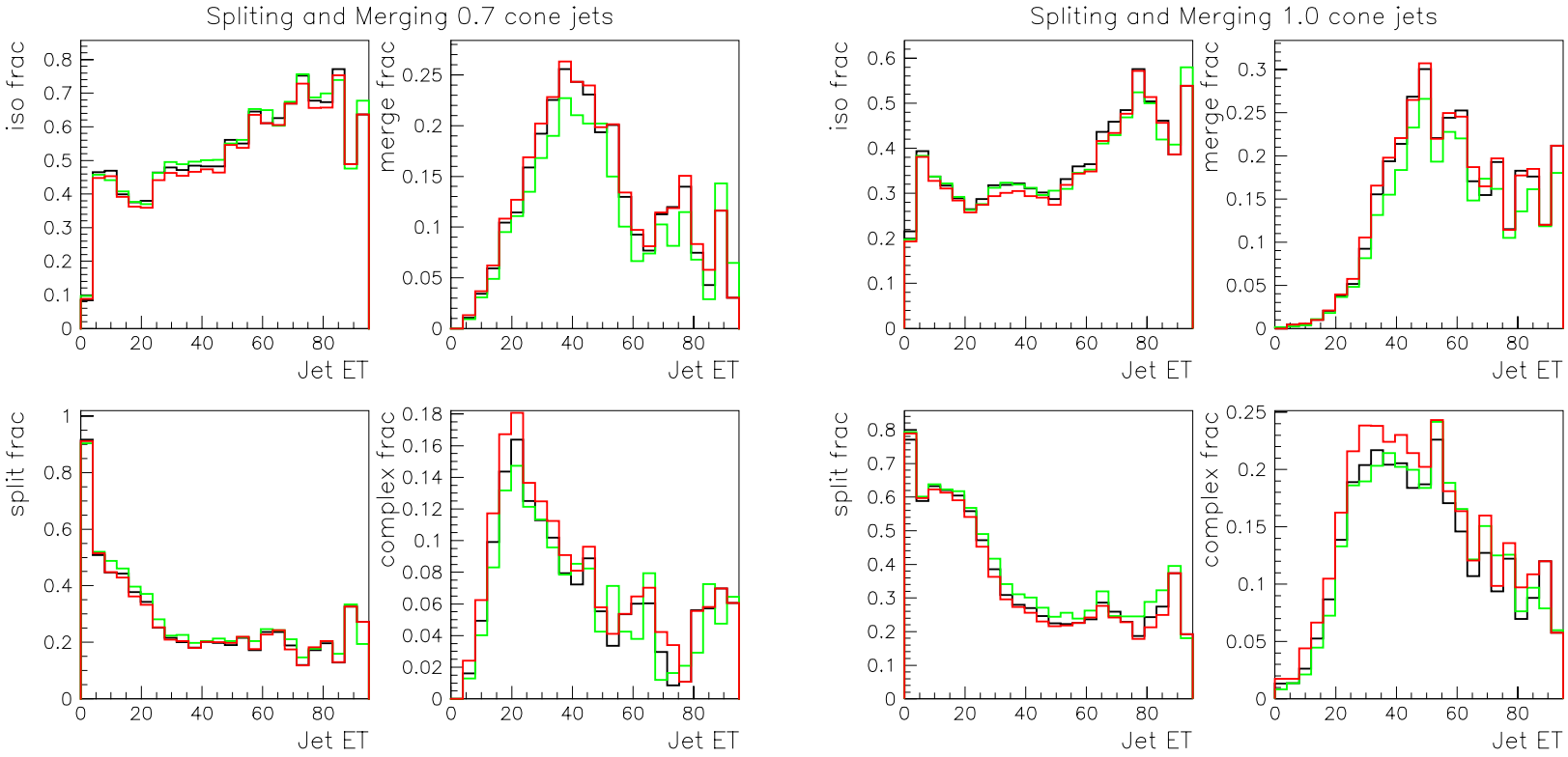
Fractions of Isolated, Split, Merged, and Complex Jets vs. ET

LCA

MidPoint

MidPoint 1st

+Interaction cut



UPDATE Bob Hirosky Sep 99 hirosky@fnal.gov

Conclusions

Effects are complex, but subtle:

•addition of midpoint seeds early or late in seed list changes jet ET spectrum by only a few percent for most cone sizes, very large cones show slightly more sensitivity

•in most cases adding mid points increases the amount of splitting/ merging of jets by a few percent

•addition of midpoints increases number of jets around threshold (in Dzero, min jet ET=8GeV) - midpoint seeds have effectively zero threshold. This effect increases w/ cone size as expected

UPDATE **Bob Hirosky Sep 99 hirosky@fnal.gov**

Conclusions

No reason NOT to use Midpoint Algorithm

•In fact, once algorithm specific resolution and escale corrections are determined and applied, the differences in the corrected jet cross sections for LCA and midpoint algs. will be further reduced!

•In absence of additional interactions and detector effects it will be interesting to see the effect of adding midpoints to clustering of MC jets

Prediction: these differences will be well w/in ‘the noise’ compared to typical experimental/theoretical uncertainties!

UPDATE **Bob Hirosky Sep 99 hirosky@fnal.gov**

And Finally...

Lets make another convention!

In the QCD@RunII jets group we have adopted conventions for clustering schemes, angle definition, and threshold criteria for splitting/merging.

In order to insure maximum uniformity between experiments and theory, we should also adopt conventions for the order in which we cluster jets and for treating multiply overlapping jets.

The ‘correct answer’ will no doubt be ambiguous, but any standard will facilitate easier communication down the road.

UPDATE **Bob Hirosky Sep 99 hirosky@fnal.gov**